STEREO Mission Design - 2

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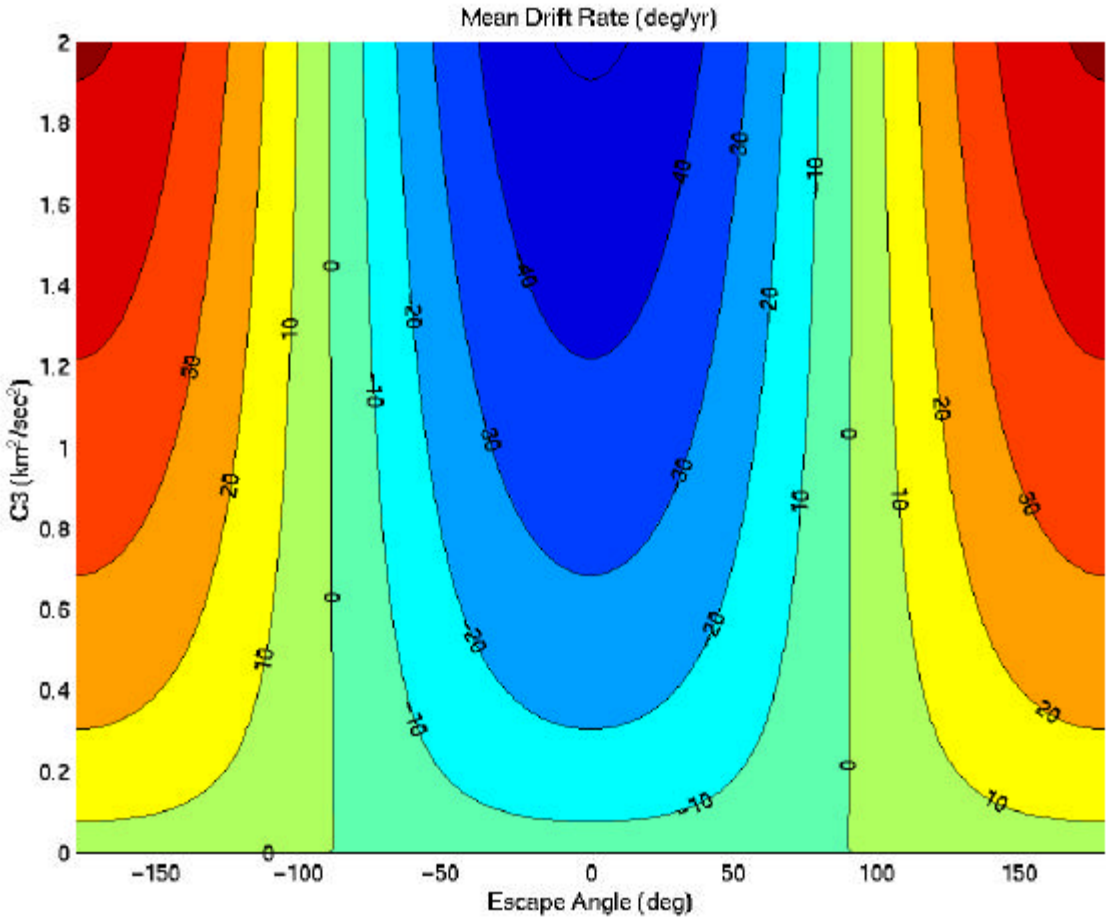
Mission Design Analysis

- Launch Vehicle Selection
- Early Mission DSN Visibility
- Eclipse Analysis
- Sun-Probe-Earth Angle Analysis
- Orbit Definition

Orbit Selection



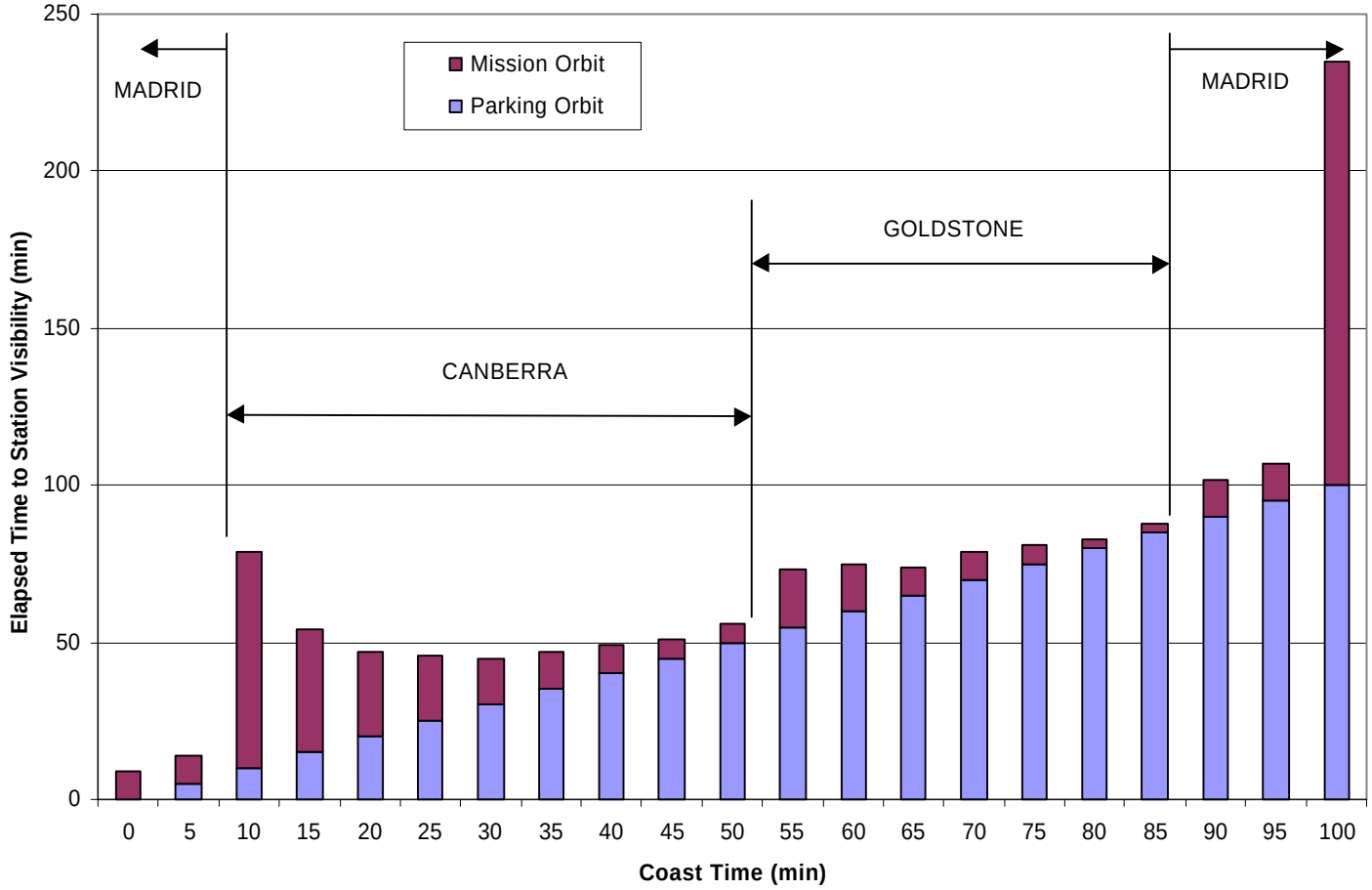
Launch Vehicle Selection

- Taurus
  - Orbital Sciences Corp. presentation
  - Definition of direct ascent profile (pending OSC response)
- Athena II
  - Lockheed Martin (LM) presentation
  - Questions submitted to LM
  - Payload mass determined by injection motor (Star-37)
- Space Shuttle
  - USA telecon
  - Payload mass determined by injection stage (Star-37, Star-48, TBD)
  - Launch Mode (1 vs. 2), On-orbit sequencing,…

Early Mission DSN Visibility

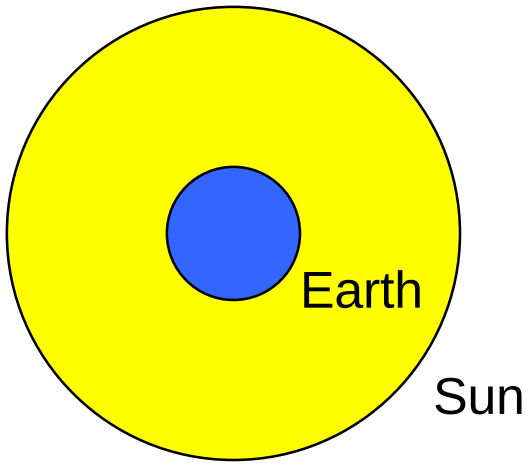
- Definitive timeline requires specification of launch date, launch vehicle, …
- Define first station visibility as function of parking orbit coast time.
- Assumptions
  - Deep Space Network (DSN) (Goldstone, Canberra, Madrid)
  - 10° minimum elevation
  - Parking Orbit
    - Launch from Eastern Range (CCAS/KSC)
    - Inclination = 28.5° (90° launch azimuth)
    - Altitude = 185 km (100 nmi)
    - ELV scenario (Shuttle requires knowledge of payload release sequence)
  - Launch Energy, C3 = 1.0 km^2/sec^2

DSN First Station Visibility



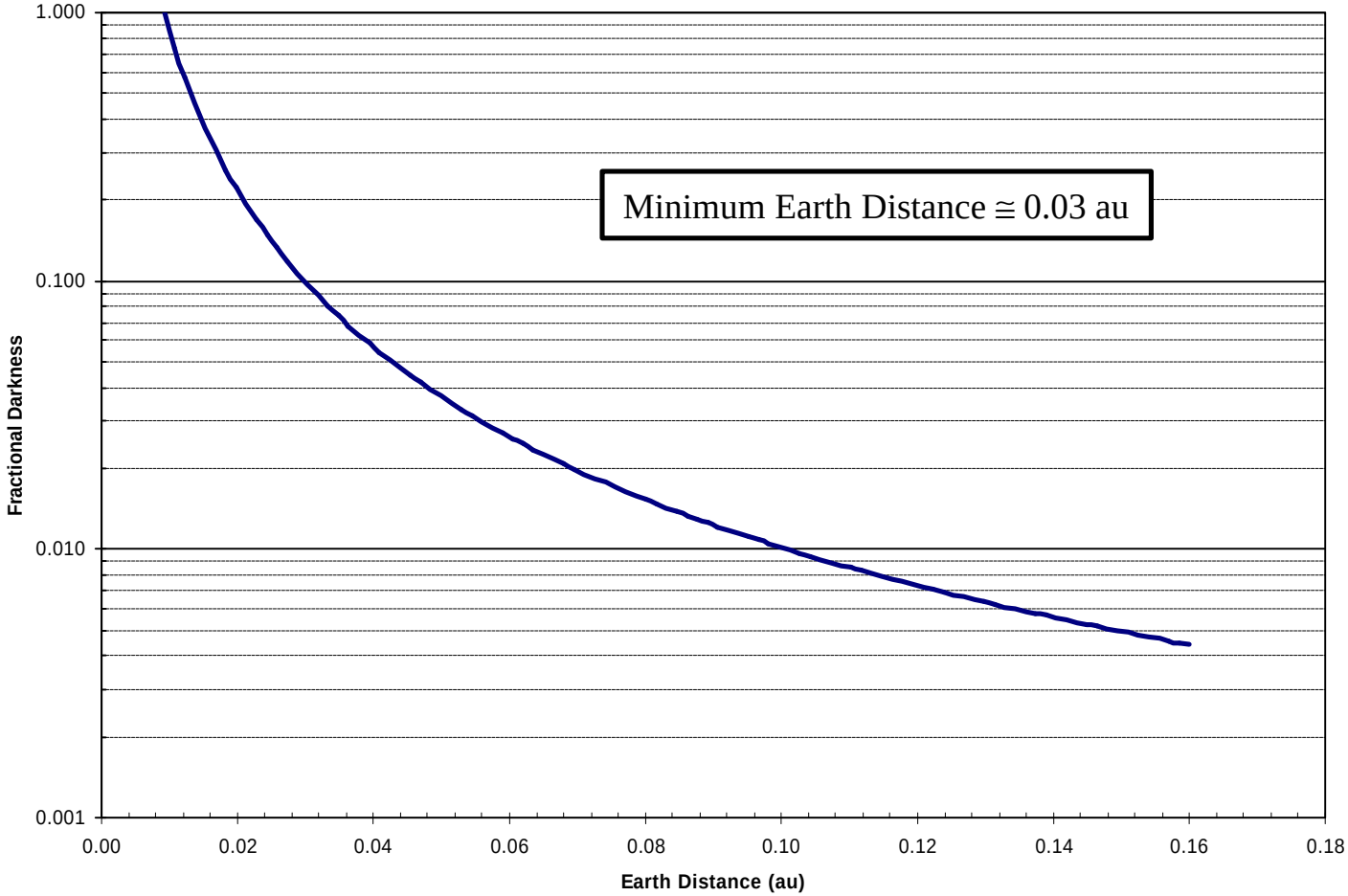
Eclipse Analysis

- Annular eclipse is possible for lagging spacecraft
- Fraction of solar disk covered is less than 10% (depends on Escape angle)
- Transit time less than 9 hrs.



Annular Eclipse as viewed from the Spacecraft

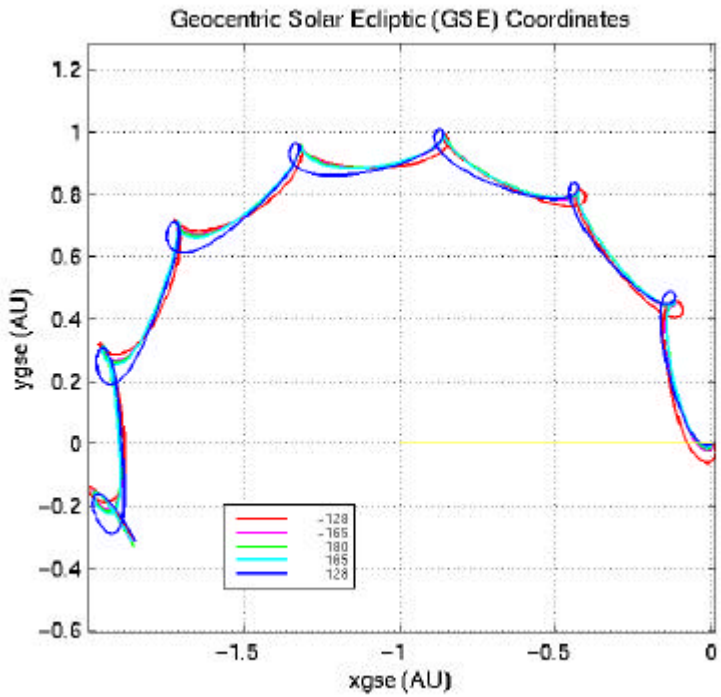
Annular Eclipse Fractional Darkness

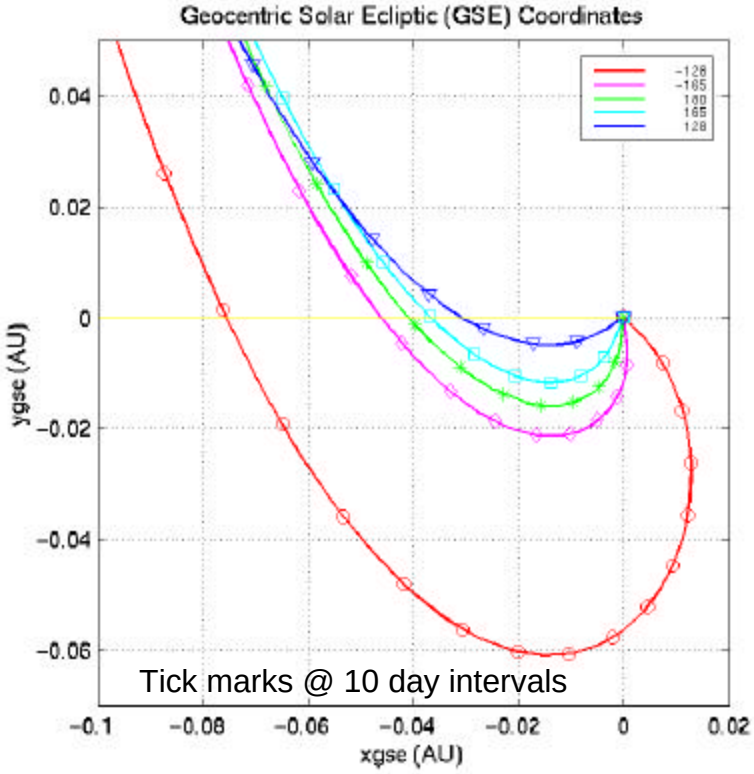


Sun-Probe-Earth Angle Analysis

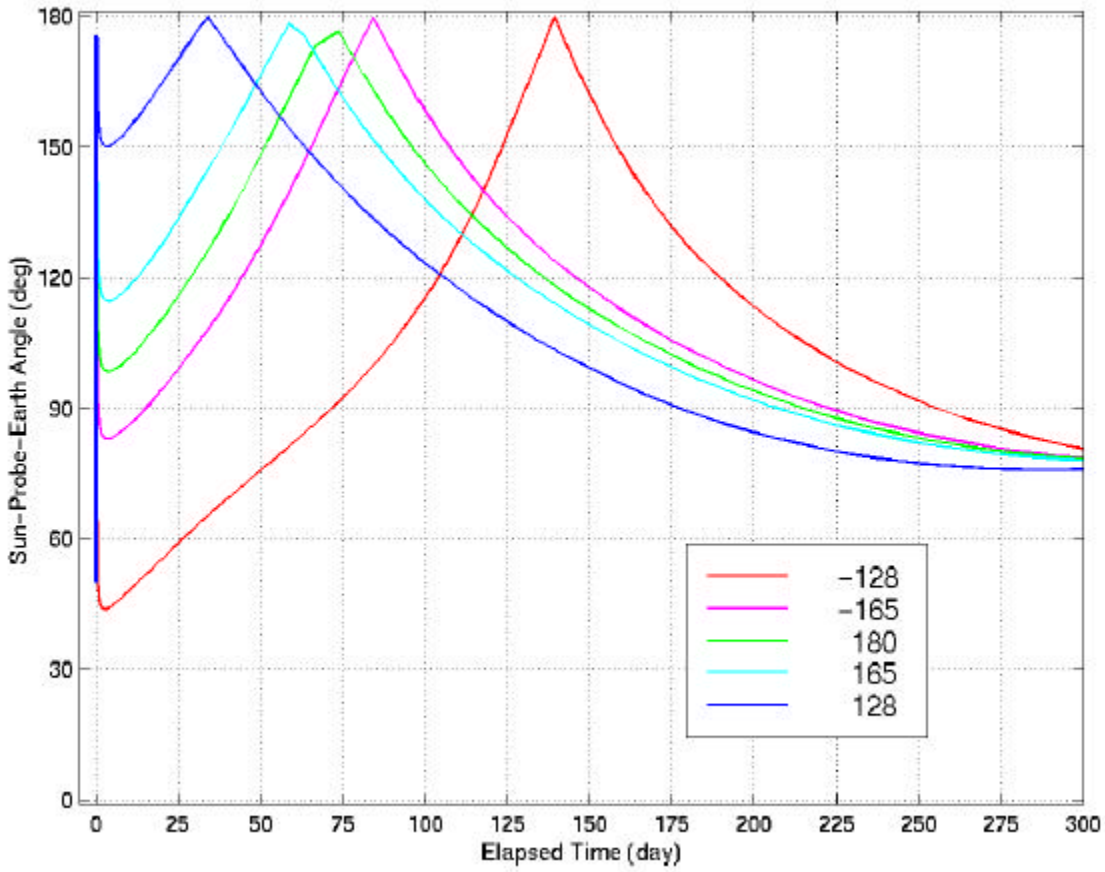
- Sun-Probe-Earth (SPE) angle defines HGA antenna gimbal range and rate for Sun-pointing attitude with HGA Earth-pointing.
- Leading trajectories initially lag the Earth as the spacecraft moves towards perihelion.
  - 'Stable' trajectories (C3>0 km^2/sec^2) have SPE angles that approach 180°
  - Spacecraft rolls 180° (EPD initially oriented in opposite direction)
  - Selection of escape direction influences time evolution of SPE
    - Maximum SPE angle
    - Time to maximum SPE angle
    - Time to SPE < 90°
- SPE data for family of 30 deg/yr trajectories
  - V_∞ in ecliptic plane (Ecliptic orbit, Max. SPE ≅ 180°)
  - $0 \leq C3 \leq 2$ km^2/sec^2

Family Portrait for 30 deg/yr Ecliptic Drift Orbits



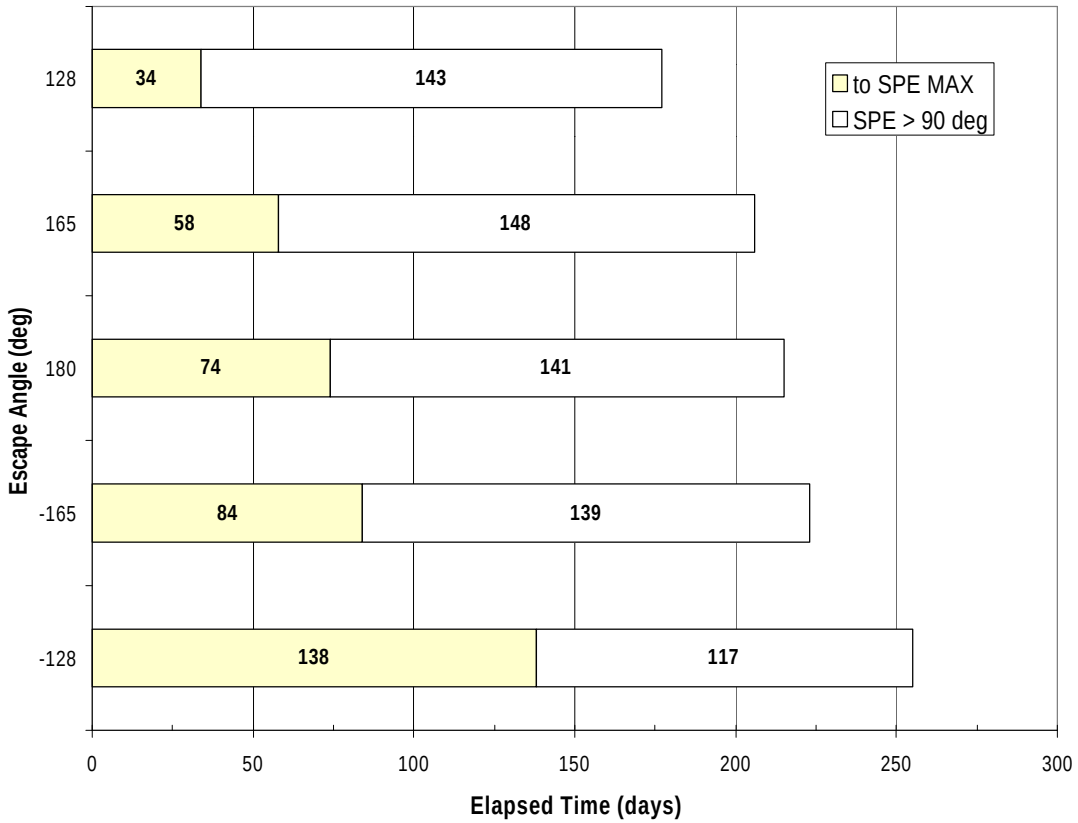


Early Mission SPE Angle History



- Leading orbit
- 30 deg/yr
- Ecliptic orbits
- Inclined orbits (TBD)
  - Max. SPE to $\cong 165°$
  - Time to SPE < 90 ° similar

SPE Angle Milestones



- Leading orbit
- 30 deg/yr
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  - Max. SPE to $\cong 165°$
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Orbit Definition

- Orbit configuration is defined by the desired time history of the spacecraft angular separation
  - Absolute spacecraft separation
  - Relative separation from Earth-Sun line
- Solar drift orbits are defined by Mean Drift Rate relative to the Earth
- Symmetric or Asymmetric configurations are achievable
  - Lead S/C Drift Rate = TBD
  - Lag S/C Drift Rate = 30 deg/yr
- Maximum Mean Drift Rate = 30 deg/yr